

MULTIMEDIA



UNIVERSITY

STUDENT ID NO

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MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2015 / 2016

PEL0016 - ELECTRICITY AND MAGNETISM
(Foundation in Engineering)

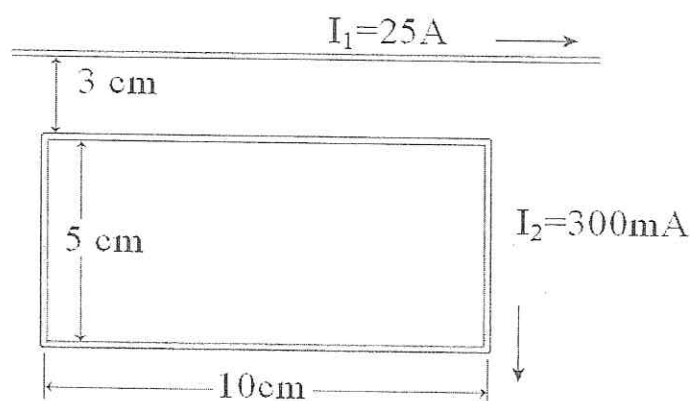
11 March 2016
3:00 PM – 5:00PM
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This question paper consists of **FIVE (5)** printed pages excluding the cover page and appendices, with **FOUR (4)** questions.
2. Answer **ALL** questions. The distribution of the marks for each question is given.
3. Please write all your answers in the Answer Booklet provided.

QUESTION 1 (15 marks)

- a) An electron travels at an angle 60° with the direction of a magnetic field of 0.4T in the y -direction. The speed of the electron is $4.00 \times 10^6 \text{ms}^{-1}$.
- Calculate the magnitude of magnetic force on the electron.
(2 marks)
 - Calculate the acceleration experienced by the electron.
(2 marks)
- b) Laboratory electromagnets produce magnetic field of magnitude of 3.0T and a proton moves through this field with a speed of $15.00 \times 10^6 \text{m/s}$.
- Find the magnitude of the maximum magnetic force that could be exerted on the proton.
(2 marks)
 - What is the magnitude of the maximum acceleration of the proton?
(2 marks)
 - Would the field exert the same magnetic force and direction if an electron moving through the field with the same speed? Explain.
(1 mark)
- c) **Figure Q1 (c)** below shows a long, straight wire carries 25 Amperes current. A 5.0 cm by 10cm rectangular wire loop carrying 300mA is 3.0cm from the wire. Find the net magnetic force on the loop.
(6 marks)

**Figure Q1 (c)****Continued...**

QUESTION 2 (15 marks)

a) **Figure Q2 (a)** below shows a combination of resistors in a circuit diagram.

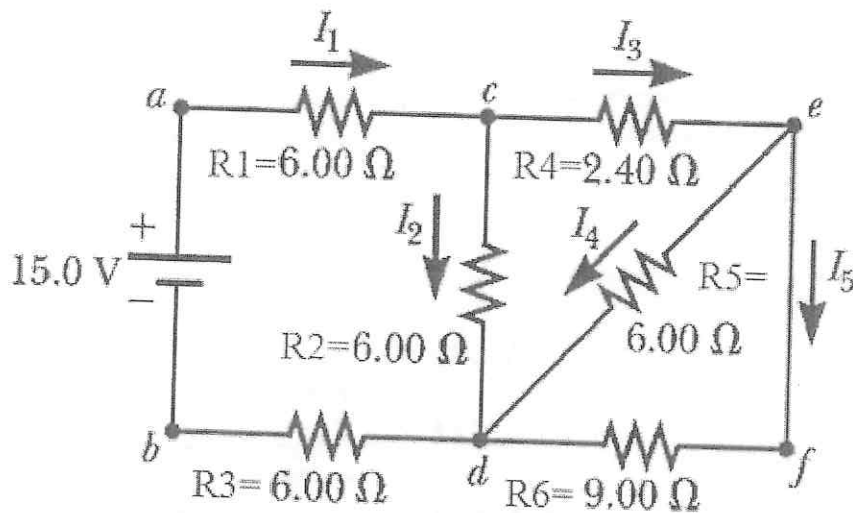


Figure Q2 (a)

- (i) Calculate the equivalent resistance between terminals a and b to replace all of the resistors in the diagram shown.
(5 marks)
- (ii) Calculate the current flowing in $R_1 = 6.00\Omega$.
(3 marks)

Continued...

b) A circuit diagram combining three resistors is shown in **Figure Q2 (b)** below.

(i) Use Kirchhoff's Laws to calculate the magnitude and direction of current flowing in each resistor, I_1 , I_2 and I_3 .

(5 marks)

(ii) Find the Thevenin's equivalent circuit in between point a - b . Thus find the I_3 , which is the current that flow through R_3 , by using the Thevenin's equivalent circuit.

(2 marks)

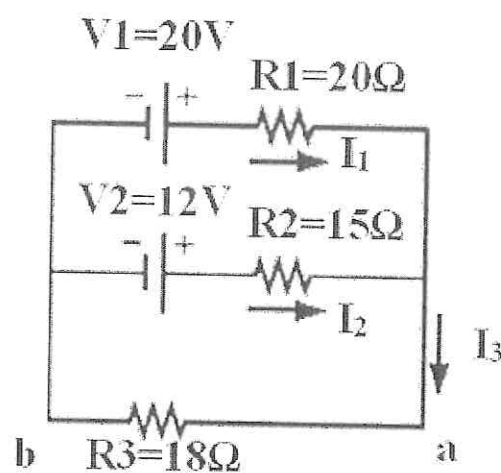


Figure Q2 (b)

Continued...

QUESTION 3 (10 marks)

a) **Figure Q3 (a)** shows three light bulbs connected to a 120-V AC (rms) household supply voltage. Bulbs 1 and 2 have a power rating of 300 W, and bulb 3 has a 50 W rating.

i. Find the rms current in each bulb

(3 marks)

ii. Find the resistance of each bulb.

(2 marks)

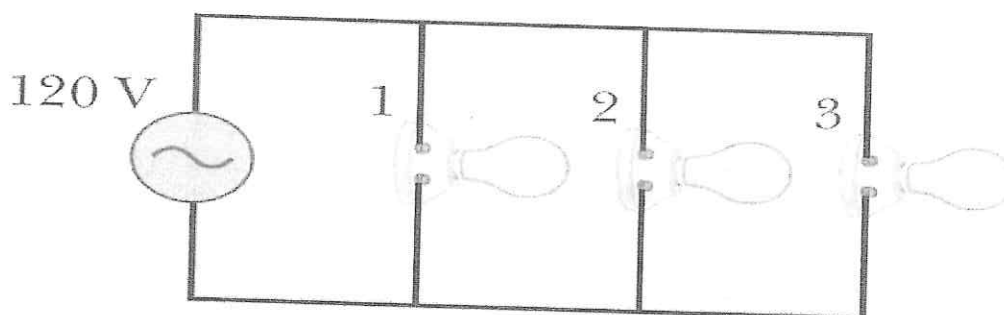


Figure Q3 (a)

b) A series AC circuit contains a resistor, an inductor of 200 mH, a capacitor of 20 mF, and a source with $\Delta V_{\text{max}} = 240$ V operating at 60.0 Hz. The maximum current in the circuit is 200 mA. Calculate:

i. the inductive reactance.

ii. the capacitive reactance.

iii. the impedance.

iv. the resistance in the circuit.

v. the phase angle between the current and the source voltage.

(1 mark)

(1 mark)

(1 mark)

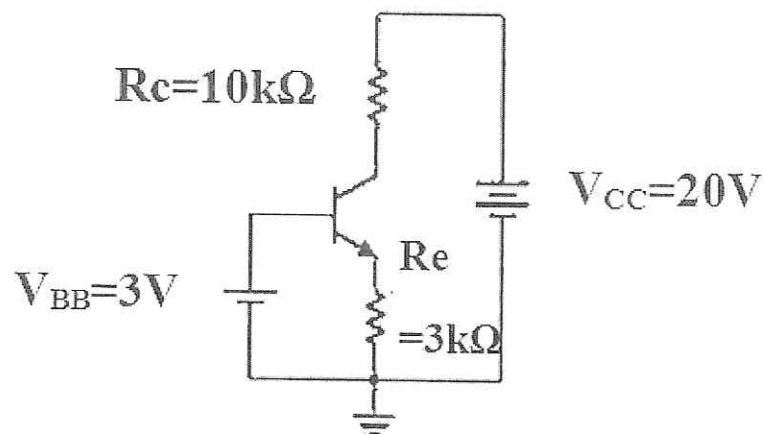
(1 mark)

(1 mark)

Continued...

QUESTION 4 (10 marks)

- a) Define Intrinsic and Extrinsic semiconductor properties. (2 marks)
- b) Define what is meant by PN junction? Explain how the depletion region can be produced in the PN junction. (2 marks)
- c) Determine I_B , I_C , I_E , V_{CE} and V_{CB} in **Figure Q4 (c)** for the following values. Given that $\beta_{dc}=100$. Assume that the transistor is of silicon type. (6 marks)

**Figure Q4 (c)****End of page**

APPENDIX 1

Physical Constants

Quantity	Symbol	Value
Electron mass	m_e	$9.11 \times 10^{-31} \text{ kg}$
Proton mass,	m_p	$1.67 \times 10^{-27} \text{ kg}$
Elementary charge	e	$1.602 \times 10^{-19} \text{ C}$
Gravitational constant	G	$6.67 \times 10^{-11} \text{ N.m}^2/\text{kg}^2$
Gas constant	R	8.314 J/K.mol
Hydrogen ground state	E_o	-13.6 eV
Boltzmann's constant	k_B	$1.38 \times 10^{-23} \text{ J/K}$
Compton wavelength	λ_c	$2.426 \times 10^{-12} \text{ m}$
Planck's constant	h	$6.626 \times 10^{-34} \text{ J.s}$
Speed of light in vacuum	c	$3.0 \times 10^8 \text{ m/s}$
Rydberg constant	R_H	$1.097 \times 10^7 \text{ m}^{-1}$
Acceleration due to gravity,	g	9.81 m/s^2
Atomic mass unit (1u)	u	$1.66 \times 10^{-27} \text{ kg}$
Avogadro's number	N_A	$6.023 \times 10^{23} \text{ mol}^{-1}$
Threshold of intensity of hearing	I_o	$1.0 \times 10^{-12} \text{ W/m}^2$
Coulomb constant	k	$8.988 \times 10^9 \text{ N.m}^2/\text{C}^2$
Permittivity of free space	ϵ_o/κ_o	$8.85 \times 10^{-12} \text{ C}^2/\text{N.m}^2$
Permeability of free space	μ_o	$4\pi \times 10^{-7} \text{ H/m}$

Energy equivalent of atomic mass unit:

One atomic mass unit (1.0 u) is equivalent to 931.5 MeV

APPENDIX II

List of formulas

$$\begin{aligned}
 A_v &= \frac{V_c}{V_b} \\
 \alpha_{dc} &= \frac{\beta_{dc}}{\beta_{dc} + 1} \\
 \beta_{dc} &= \frac{\alpha_{dc}}{1 - \alpha_{dc}} \\
 B &= \frac{\mu_0 I}{2\pi r} \\
 B &= \mu_0 n I \\
 \xi &= V + Ir \\
 \xi &= blv \\
 \xi &= -N \frac{\Delta\Phi}{\Delta t} \\
 \xi &= -L \frac{dI}{dt} \\
 \xi &= -M \frac{dI}{dt} \\
 F &= BIL \sin \theta \\
 F &= qvB \sin \theta \\
 \frac{F}{\ell} &= \frac{\mu_0 I_1 I_2}{2\pi d} \\
 f_r &= \frac{1}{2\pi\sqrt{LC}} \\
 I_{tot} &= \sqrt{I_R^2 + (I_L - I_C)^2} \\
 I &= neA(v_n + v_p) \\
 I &= nev_d A \\
 I &= I_{max} \sin \omega t \\
 I_{rms} &= \frac{I_{max}}{\sqrt{2}} \\
 I_x &= \left(\frac{R_T}{R_x} \right) I_T \\
 L &= \frac{N\Phi_B}{I} \\
 L &= \frac{\mu_0 N^2 A}{l} \\
 M &= \frac{N\Phi_B}{I} \\
 M &= \frac{\mu_0 N_1 N_2 A}{l} \\
 P &= IV = I^2 R = \frac{V^2}{R} \\
 P_t &= I_{rms} V_{rms} \cos \phi \\
 P_r &= V_{rms} I_{rms} \sin \phi \\
 P_a &= I_{rms}^2 Z \\
 R &= \frac{\rho L}{A} \\
 R &= R_0 [1 + \alpha(T - T_0)] \\
 R_T &= R_1 + R_2 + R_3 + \dots \\
 \frac{1}{R_T} &= \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \dots \\
 r &= \frac{mv}{Bq} \\
 \tau &= NBIA \sin \theta \\
 U &= \frac{1}{2} LI^2 \\
 U &= \frac{1}{2} B^2 A \frac{l}{\mu_0} \\
 V_H &= Bvd \\
 V &= V_{max} \sin \omega t \\
 V_{rms} &= \frac{V_{max}}{\sqrt{2}} \\
 V_x &= \left(\frac{R_x}{R_T} \right) V_s \\
 X_C &= \frac{1}{2\pi f C} \\
 X_L &= 2\pi f L \\
 Z &= \sqrt{R^2 + (X_L - X_C)^2} \\
 \oint B \cdot dl &= \mu_0 I \\
 d\mathbf{B} &= \frac{\mu_0 I}{4\pi} \frac{d\ell \times \hat{r}}{r^2} \\
 \Phi_B &= BA \cos \theta \\
 \cos \phi &= \frac{R}{Z} \\
 \tan \phi &= \frac{X_L - X_C}{R}
 \end{aligned}$$